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**UTILITY PATENT APPLICATION TRANSMITTAL**  
**(Only for new nonprovisional applications under 37 CFR 1.53(b))**

cket No. : 39647/DBP/Y35  
 Inventor(s) : Bong-Woo Lee et al.  
 Title : CATHODE RAY TUBE  
 Express Mail Label No. : EL408323396US

**ADDRESS TO:** Assistant Commissioner for Patents  
 Box Patent Application  
 Washington, D.C. 20231

Date: June 21, 2000

1. ☒ **FEE TRANSMITTAL FORM** *(Submit an original, and a duplicate for fee processing).*

2. **IF A CONTINUING APPLICATION**

\_\_\_\_\_ This application is a \_\_\_\_\_ of patent application No. .

Prior application information: Examiner ; Group Art Unit:

\_\_\_\_\_ This application claims priority pursuant to 35 U.S.C. §119(e) and 37 CFR §1.78(a)(4),  
 to provisional Application No. .

3. **APPLICATION COMPRISED OF**

**Specification**

12 Specification, claims and Abstract (total pages)

**Drawings**

2 Sheets of drawing(s) (FIGS. 1 to 3)

**Declaration and Power of Attorney**

☒ Newly executed

\_\_\_\_\_ No executed declaration

\_\_\_\_\_ Copy from a prior application (37 CFR 1.63(d))(for continuation and divisional)

4. \_\_\_\_\_ **Microfiche Computer Program** *(Appendix)*

5. \_\_\_\_\_ **Nucleotide and/or Amino Acid Sequence Submission** *(if applicable, all necessary)*

\_\_\_\_\_ Computer Readable Copy

\_\_\_\_\_ Paper Copy (identical to computer copy)

\_\_\_\_\_ Statement verifying identity of above copies

6. **ALSO ENCLOSED ARE**

\_\_\_\_\_ Preliminary Amendment

\_\_\_\_\_ A Petition for Extension of Time for the parent application and the required fee are  
 enclosed as separate papers

\_\_\_\_\_ Small Entity Statement(s)

\_\_\_\_\_ Statement filed in parent application, status still proper and desired

\_\_\_\_\_ Copy of Statement filed in provisional application, status still proper and desired

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**UTILITY PATENT APPLICATION TRANSMITTAL**  
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Docket No.: 39647/DBP/Y35

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- ☒ An Assignment of the invention with the Recordation Cover Sheet and the recordation fee are enclosed as separate papers
- ☐ This application is owned by pursuant to an Assignment recorded at Reel , Frame
- ☐ Information Disclosure Statement (IDS)/PTO-1449
- ☐ Copies of IDS Citations
- ☒ Certified copy of Priority Document(s) (*if foreign priority is claimed*)
- ☐ English Translation Document (*if applicable*)
- ☒ Return Receipt Postcard (MPEP 503) (should be specifically itemized).
- ☐ Other

**7. CORRESPONDENCE ADDRESS**

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626/795-9900

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## CATHODE RAY TUBE

### BACKGROUND OF THE INVENTION

#### **(a) Field of the Invention**

The present invention relates to a cathode ray tube, more particularly,  
5 to a cathode ray tube having an improved funnel, on which the deflection yoke  
is mounted, capable of decreasing deflection power.

#### **(b) Description of the Related Art**

In a well-known cathode ray tube, electron beams emitted from an  
electron gun assembly are deflected to a phosphor screen in a horizontal and  
10 vertical direction. The electron beams impinge on a corresponding phosphor  
pixel, resulting in emission of light to form images or characters.

Cathode ray tubes are mainly installed in color televisions or computer  
monitors to be provided to consumers. Recently, cathode ray tubes have been  
enhanced to be installed in High-Definition televisions (HDTV).

15 In order to cope with OA equipment, e.g., an HDTV or monitor for a PC,  
either the deflection frequency must be increased, or the anode voltage for  
finally accelerating the electron beams must be increased. An increase in  
anode voltage and an increase in deflection frequency cause an increase in  
deflection power, i.e., an increase in consumption power of the deflection yoke.

20 In order to solve these problems, the neck diameter of conventional  
cathode ray tubes has been decreased, and the deflection magnetic field  
generated from the deflection yoke is likely to approach the trajectories of the

electron beams so that the deflection power efficiency can be improved.

However, since the neck diameter is decreased, it is difficult to manufacture the cathode ray tube, and the focus characteristics of the electron gun assembly are deteriorated.

5 Therefore, in another conventional cathode ray tube, the neck diameter is maintained (about  $\phi 29.1$  mm), but the outer diameter of the funnel near the neck side is decreased, so that the deflection power is reduced. However, when an electron beam is deflected in a direction along the maximum size of the screen, i.e., along the diagonal direction, the electron beam passes close to the inner surface of the funnel near the neck side on which the deflection yoke is mounted. This situation is called a BSN (Beam Strikes the Neck) problem. For this reason, the resultant image is not properly formed.

10 In this cathode ray tube, since the neck diameter is simply decreased through the experience of a designer or trial and error, it is difficult to effectively solve the BSN problem. Accordingly, it is difficult to decrease the deflection power.

### **SUMMARY OF THE INVENTION**

15 In view of the prior art described above, it is an object of the present invention to provide a cathode ray tube capable of reducing the deflection power while preventing a BSN problem.

20 To achieve this object, as embodied and broadly described herein, the invention comprises

a panel, a phosphor screen being arranged on an inner surface of the panel;

a funnel having a deflection yoke on an outer periphery thereof, including:

5 a body connected to the panel; and

a cone connected to the body; and

a neck, connected to the cone of the funnel, having an electron gun disposed therein. The cone has a deflection power reducing shape which is formed to have a range of length  $0.25 \times L$  from an end of the cone at the neck where L is an entire length of the cone measured along an axis of symmetry of the cathode ray tube.

According to an aspect of the present invention, the deflection power reducing means is formed in such a manner that the outline of the cone has a shape of an arc on a range of the length  $0.25 \times L$  from the end of the cone at the neck as viewed in a cross section perpendicular to the axis of symmetry and satisfies the following conditions:

$$|Cz| < 4.5 \text{ mm}$$

$$25 \text{ mm} < r1 < 50 \text{ mm}$$

where Cz is a coordinate of a center of the aforementioned arc; and

20 r1 is a radius of curvature of the arc.

According to another aspect of the present invention, the deflection power reducing means is formed in such manner that the outline of the cone has a curvature on a range of the length  $0.25 \times L$  from the end of the cone at

the neck as viewed in a cross section perpendicular to the axis of symmetry and satisfies the following conditions:

$$0.26 < R < 0.43$$

where R is an average variation of height measured from the axis of symmetry to the each point of the curvature.

Both foregoing general description and the following Detailed Description are exemplary and are intended to provide further explanation of the invention as claimed.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

The accompanying drawings provide a further understanding of the invention and, together with the Detailed Description, explain the principles of the invention. In the drawings:

Fig. 1 shows a cross section of a cathode ray tube, as viewed in a cross section perpendicular to the axis of symmetry, according to a first preferred embodiment of the present invention;

Fig. 2 illustrates a cone of a funnel according to the first preferred embodiment of the present invention; and

Fig. 3 illustrates a cone of a funnel according to a second preferred embodiment of the present invention.

#### **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS**

The present invention will be described in detail with reference to the

accompanying drawings.

Referring to Fig. 1, a cathode ray tube is formed with a vacuum envelope having a substantially rectangular panel 3, a funnel 5 formed contiguous to the panel 3, and a cylindrical neck 9 formed contiguous to the funnel 5. A phosphor screen 1 is formed on the inner surface of the panel 3. A deflection yoke (not shown) is mounted on the outer side of the funnel 5 near the neck 9.

Electron beams B emitted from the electron gun 7 scan the phosphor screen 1. In order to effectively deflect the electron beams, the funnel 5 is shaped as follows:

First, the funnel 5 has a body 50a formed contiguous to a seal surface of the panel 3, and a cone 50b formed between the body 50a and the neck 9.

The inventors of the present invention improve the shape of the cone 50b. According to a first embodiment of the present invention, reference Z indicates an axis of symmetry of the cathode ray tube, while reference O indicates an origin which is an end of the cone 50b near the neck 9. Reference L is an entire length of the cone 50b, which is measured on the axis of symmetry Z.

In order to form the funnel 5, the cone 50b is formed in such a manner that the outer periphery of the cone 50b has a predetermined curvature which is contiguous to the body 50a, as viewed in a cross section perpendicular to the Z axis. Specifically, the outline of the cone 50b has a shape of an arc A on a range from the origin 0 to a position 25% of the entire length L (the length 0.25

× L) from the origin as viewed in a cross section perpendicular to the Z axis.

The center (Cz, Cy) and the radius of curvature r1 of the arc A are set to satisfy the following conditions:

$$|Cz| < 4.5 \text{ mm}$$

$$25 \text{ mm} < r1 < 50 \text{ mm}.$$

If the absolute value of the center coordinate Cz exceeds 4.5 mm, the curvature of the arc A in the cone 50b changes abruptly, resulting in strength risk of the cathode ray tube. Further, the deflection efficiency is reduced if the radius of curvature r1 is larger than 50 mm, while the BSN of electron beams deteriorates if the radius of curvature r1 is smaller than 25 mm.

The above parameters Cz and r1 are preferably set to 2.81 mm and 28.95 mm respectively, according to the first embodiment of the present invention. Another center coordinate Cy is preferably set to 43.39 mm. The parameter Cz is positive when the center is located toward the neck 9 from the origin O, while the parameter Cz is negative when the center is located toward the cone 50b from the origin O.

The cone of the funnel which satisfies the above conditions has a smaller diameter than that of a prior art funnel at a dashed line P in Fig.2. The inventors of the present invention have noted through a plurality of computer simulations that the deflection yoke mounted on the cone according to the present invention effectively deflects electron beams without any BSN problems.

The inventors have also noted that the magnetic deflection field (specifically a horizontal field) which is generated by the deflection yoke



mounted on the cone according to the present invention approaches the trajectories of the electron beams, thereby reducing deflection power. According to the first preferred embodiment, the deflection power is decreased by 9.76% with respect to the prior art for a 17-inch cathode ray tube (deflection angle: 90°). Table 1 shows parameters of the above conditions for a 17-inch cathode ray tube according to the present invention and prior art.

Table 1

	Cz (mm)	Cy (mm)	R1 (mm)	Deflection power
Present invention	2.81	43.39	28.95	90.24%
Prior art	4.99	105.86	91.45	100%

A second preferred embodiment of the present invention will now be described with reference to Fig. 3. The cathode ray tube according to the second preferred embodiment has similar structures to the first preferred embodiment, and further descriptions thereof will not be made. Referring to Fig. 3, the cone 50b is formed in such a manner that the outline of the outer periphery of the cone 50b has a curvature which is contiguous to the body 50a, as viewed in a cross section perpendicular to the Z axis. Specifically, the outline of the cone 50b has a predetermined average variation of height h on a range of the Z axis to a position 25% of the entire length L (the length  $0.25 \times L$ ) from the origin 0 as viewed in a cross section perpendicular to the Z axis. The height h is measured from the Z-axis to the outer periphery of the cone 50b. The average variation of the height h is set to satisfy the following condition:

$$0.26 < R < 0.43$$

where R is average variation of height h ( $R = \Delta h / \Delta z |_{\text{average}}$ ).

The BSN of electron beams deteriorates if the average variation R is higher than 0.43, while the deflection efficiency is reduced if the average variation R is lower than 0.26.

The above parameter R is preferably set to 0.26 according to the second embodiment of the present invention. The cone of the funnel which satisfies the above condition has a smaller diameter than that of a prior art at a dashed line P in Fig. 3. The inventors of the present invention have noted through computer simulations that the deflection yoke mounted on the cone according to the present invention deflects electron beams without BSN problems.

The inventors also have noted that the magnetic field (specifically the horizontal field) which is generated by the deflection yoke mounted on the cone according to the present invention approaches the trajectories of the electron beams, thereby reducing deflection power. According to the first preferred embodiment, the deflection power is decreased by 9.76% with respect to the prior art for a 17-inch cathode ray tube (deflection angle: 90°). Table 2 shows parameters of the above conditions for a 17-inch cathode ray tube according to the present invention and prior art.

Table 2

	R	Deflection power
Present invention	0.41	90.24%
Prior art	0.18	100%

An inner shape of the funnel 5 comprising the cone 50b is preferably formed with a similar curvature to the outer shape of the funnel. A thickness of the funnel is preferably determined by considering the BSN of the electron beam and atmospheric pressure tolerance.

It will be apparent to those skilled in the art that various modifications and variations can be made to the device of the present invention without departing from the spirit and scope of the invention. The present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

**WHAT IS CLAIMED IS:**

1. A cathode ray tube comprising:

a panel, a phosphor screen being arranged on an inner surface of the panel;

a funnel having a deflection yoke on an outer periphery thereof, including:

a body connected to the panel; and

a cone connected to the body; and

a neck, connected to the cone of the funnel, having an electron gun disposed therein,

wherein the cone has a deflection power reducing shape which is formed to have a range of length  $0.25 \times L$  from an end of the cone at the neck where  $L$  is an entire length of the cone measured along an axis of symmetry of the cathode ray tube.

2. The cathode ray tube as recited in claim 1, wherein the deflection power reducing shape is formed in such a manner that the outline of the cone has a shape of an arc on the range of the length  $0.25 \times L$  from the end of the cone at the neck as viewed in a cross section perpendicular to the axis of symmetry and satisfies the following conditions:

$$|Cz| < 4.5 \text{ mm}$$

$$25 \text{ mm} < r1 < 50 \text{ mm}.$$

where  $Cz$  is a coordinate of a center for the arc in the axis of symmetry direction from the end of the cone at the neck; and

r1 is a radius of curvature of the arc.

3. The cathode ray tube as recited in claim 1, wherein the deflection power reducing shape is formed in such a manner that the outline of the cone has a curvature on the range of the length  $0.25 \times L$  from the end of the cone at the neck along the entire length as viewed in a cross section perpendicular to the axis of symmetry and satisfies the following condition:

$$0.26 < R < 0.43$$

where R is an average variation of height measured from the axis of symmetry to the each point of the curvature.

## **ABSTRACT OF THE DISCLOSURE**

A cathode ray tube for reducing a deflection power without any BSN problem is disclosed. The cathode ray tube has a panel, a funnel having a deflection yoke on an outer periphery thereof, and a neck connected to the cone of the funnel. A phosphor screen is arranged on an inner surface of the panel. The funnel includes a body connected to the panel, and a cone connected to the body. The cone has a deflection power reducing shape which is formed to have a range of length  $0.25 \times L$  from an end of the cone at the neck where L is an entire length of the cone measured along an axis of symmetry of the cathode ray tube.

FIG.1

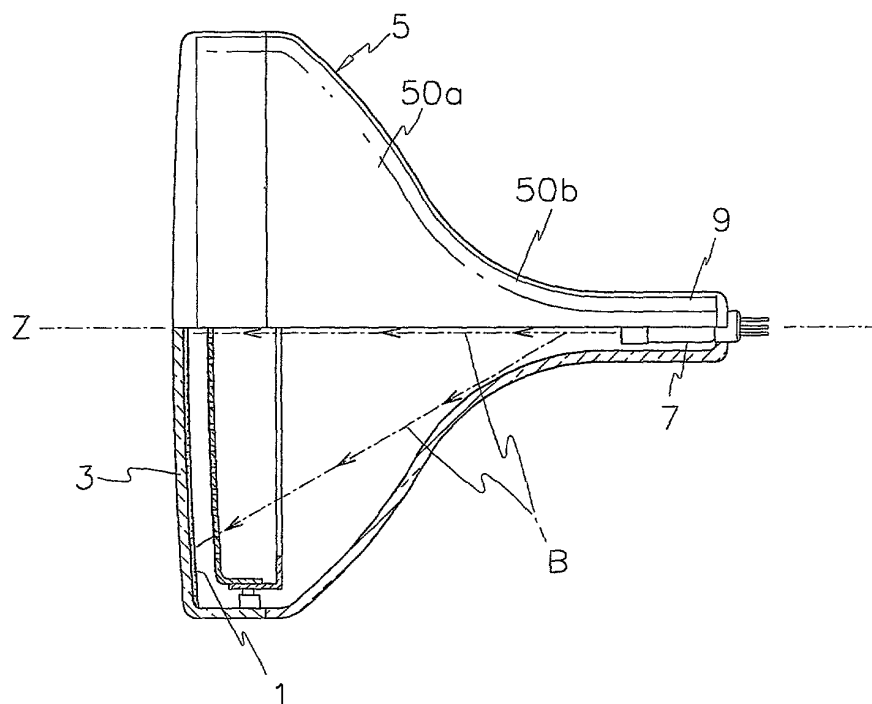


FIG.2

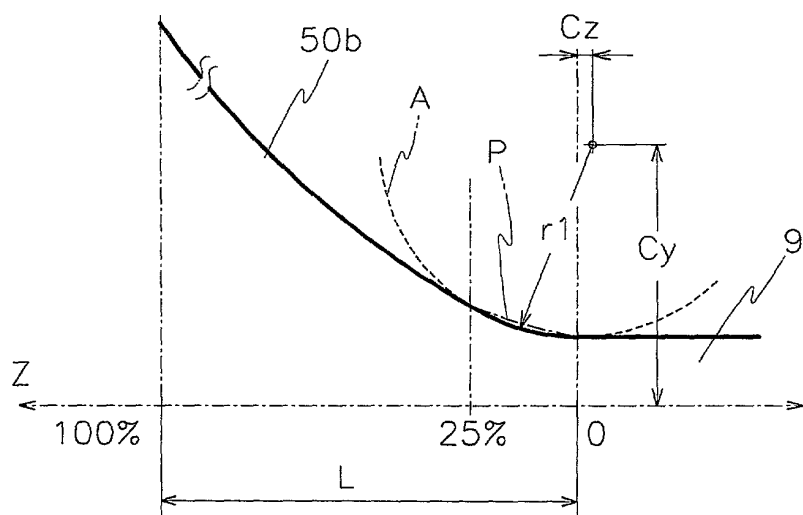
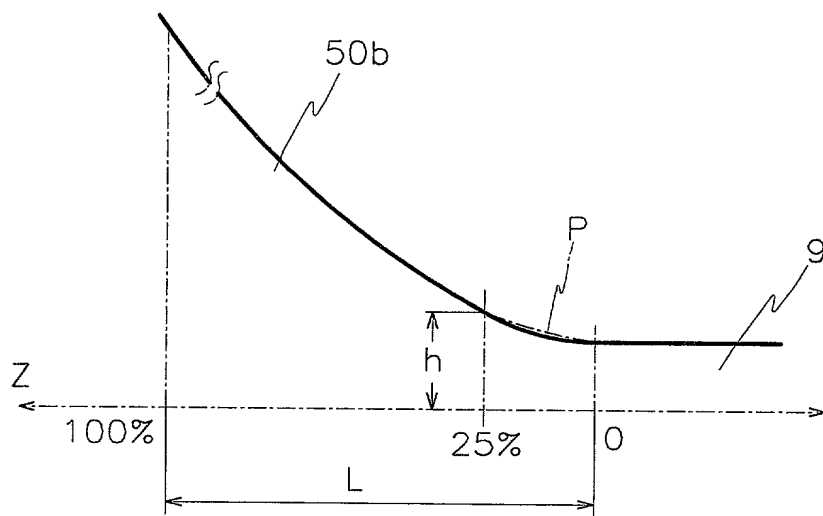


FIG.3





**DECLARATION AND POWER OF ATTORNEY  
FOR PATENT APPLICATIONS**

Docket No.: 39647/DBP/Y35

Attorney : D. Bruce Prout, Esq.

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled "**CATHODE RAY TUBE**", the specification of which is attached hereto unless the following is checked:

Was filed on \_\_\_\_\_ as United States Application Number or PCT International Application Number \_\_\_\_\_ and was amended on \_\_\_\_\_ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR § 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. § 119(a)-(d) or § 365(b) of the foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)

<u>Application Number</u>	<u>Country</u>	<u>Filing Date (day/month/year)</u>	<u>Priority Claimed</u>
99-24354	Korea	25/06/1999	Yes
99-26918	Korea	05/07/1999	Yes

I hereby claim the benefit under 35 U.S.C. § 119(e) of any United States provisional application(s) listed below.

<u>Application Number</u>	<u>Filing Date</u>

I hereby claim the benefit under 35 U.S.C. § 120 of any United States application(s), or any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. § 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR § 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application:

<u>Application Number</u>	<u>Filing Date</u>	<u>Patented/Pending/Abandoned</u>

**POWER OF ATTORNEY:** I hereby appoint the following attorneys and agents of the law firm CHRISTIE, PARKER & HALE, LLP to prosecute this application and any international application under the Patent Cooperation Treaty based on it and to transact all business in the U.S. Patent and Trademark Office connected with either of them in accordance with instructions from the assignee of the entire interest in this application; or from the first or sole inventor named below in the event the application is not assigned; or from YOU ME PATENT & LAW FIRM in the event the power granted herein is for an application filed on behalf of a foreign attorney or agent.

**DECLARATION AND POWER OF ATTORNEY  
FOR PATENT APPLICATIONS**

Docket No.: 39647/DBP/Y35

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The authority under this Power of Attorney of each person named above shall automatically terminate and be revoked upon such person ceasing to be a member or associate of or of counsel to that law firm.

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626/795-9900; 213/681-1800

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I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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